



# Autonomous agricultural robots

A revolution in the making

Carlo Cloet, Innovation Engineer, CNHi Zedelgem  
December 15, 2022

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CNHi Zedelgem

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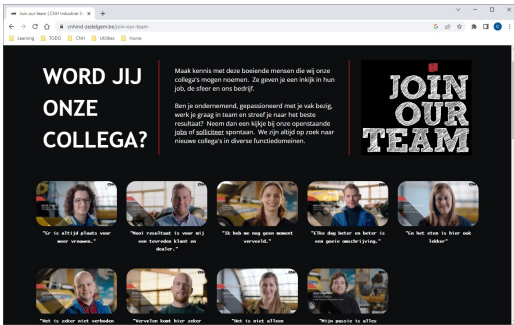
Types of robots

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# CNHi Zedelgem

www.cnhind-zedelgem.be



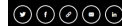
<https://cnhind-zedelgem.be/join-our-team>

# Robots at CNHi



## CNH Industrial presents first electric tractor prototype with autonomous features

Release Date: 09 Dec 2022



Zero emissions farming solution enhances value and delivers next step in the Company's innovation plan

London, December 9, 2022 – CNH Industrial revealed the **New Holland T4 Electric Power** – the industry's first all-electric light utility tractor prototype with autonomous features – at its **Tech Day** in Phoenix,

## Case IH and Raven unveil autonomous spreader

CASE IH and Raven Industries have introduced the agriculture industry's first large-scale autonomous spreader - the Case IH Trident 5550 applicator.



FARM MECHANISATION

## Case IH introduces FieldXplorer technology for sugarcane plantations in Thailand

September 12, 2022 - by Agriculture Post - Leave a Comment

### Technology > Autonomous machinery

Unveiled at the Farm Progress Show 2022 last month in Iowa, it was built to help solve labour challenges and increase on-farm productivity.

19 September 2022

Comments: 0

Share: 0

Staff Writer

"This is a significant milestone in our accelerated product development strategy, highlighting our intense collaboration and joint investment in the acquisition of Raven in late 2021," said Scott Sorenson, CEO of Case IH.

The applicator, with Raven's **Autonomy**, allows for one or more operators to manage the machine without an operator present in the cab.



All Austroff 9000 sugarcane harvesters are built ready with the latest innovations in sugarcane production including Case IH auto guidance, known as AFS AccuGuide

Precision technology has reached new heights with GPS-enabled drones now able to interact with Case IH AFS (Advanced Farming Systems) software, providing accurate and real-time intelligence to help make on-farm decisions.

# Why robots in agriculture?

## Driving factors

- Organic farming
- Labor shortage
- Repetitive/demanding tasks
- Operator safety
- Soil compaction
- Noise pollution
- Efficient resource usage
- Data collection

## Soil compaction is not your friend

BY DAN WIERSMA AND EV THOMAS, OAK POINT AGRONOMICS LTD

Wiersma is the afflu business manager with Corteva Agriscience. Thomas is retired from the William H. Miller Agricultural Research Institute and president of Oak Point Agronomics Ltd.



Soil compaction can significantly affect crop growth since it changes biological characteristics of soil.

Image: <https://hoards.com>

## Worker Shortage Threatens U.S. Ag Sustainability



Wierma is the afflu business manager with Corteva Agriscience. Thomas is retired from the William H. Miller Agricultural Research Institute and president of Oak Point Agronomics Ltd.

**Bijna één op de tien Belgische kinderen woont in gebied met hoog risico op verontreiniging door pesticiden: Groen wil 35% van Vlaanderen pesticidenvrij maken**

Ons land doet het slecht op het vlak van blootstelling van kinderen aan pesticiden. Dat zou kunnen leiden tot een reeks aandoeningen, van astma tot kanker. In Europa doet enkel Tjechië en Polen het slechter. Groen wil het pesticidengebruik uithouven en alvast 35 procent van Vlaanderen pesticidenvrij maken.

Laatst bijgewerkt: 15-12-2022 09:02 Laatste update: 09:25

Image: <https://www.pesticidereform.org/>

# Robot types

Source: FIRA 2021

## Weeding robots

### Why weeding robots?

- Weed management >40% of the labor effort
- Herbicides high environmental impact
- Up to 60% yield losses



## Seeding robots

### Why seeding robots?

- Accurate plant densities contribute to high yields
- Precision seeding is gaining ground

### State of play

- Limited research and prototypes focused on cereals
- >90% accuracy, +/- 5cm errors



## Disease, insect detection

### Why disease/insect detection robots?

- Significant economic damage
- High environmental impact

### State of play

- At its infancy, especially insect detection
- Hard to convince farmers
- Highly complex task
- Vision based detection, accuracies >90%



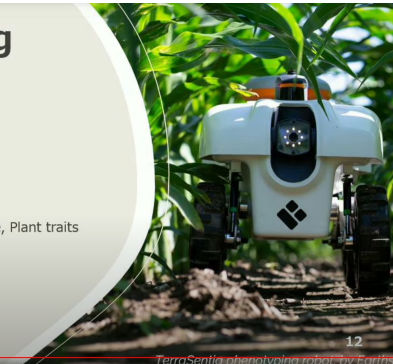
## Crop Scouting robots

### Why crop scouting robots?

- Plant vigor monitoring
- Phenotyping

### State of play

- Focus on orchards and vineyards
- Vegetation Indexes, Canopy volume, Plant traits
- Costly sensors
- Various Immature solutions



# Robot types

Source: FIRA 2021

## Harvesting robots

### Why harvesting robots

- Labor-intensive and repetitive task
- Harvesting within certain timeslot

### State of play

- Bulk and selective harvesting robots
- Two main picking mechanisms grippers & suction
- Focus on strawberries, tomatoes and apples
- Crop dependent picking speeds and rates



Tomato-picking robot by Metromation

## Plant management robots

### Why plant management robots?

- Pruning, thinning, de-leafing directly linked to fruit quality and yield

### State of play

- Limited research and commercial solutions
- Focus on vineyards and greenhouse crops



Kompago de-leafing robot by P...

## Multi Purpose robots

### Why multi purpose robots?

- Most field operations 1-2 times/ year
- Short period of use/ task
- Sharing between neighbors not feasible
- Shorter depreciation period

### State of play

- Platforms with various already mounted implements/tools
- Platforms with different mountable implements/tools
- Modular robots
- Different sensors per task
- No mature solutions



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## Spraying Robots

### Why spraying robots

- Fertilizers/Herbicides/Fungicides/...
- Reduce farmer exposure to chemicals

### State of play

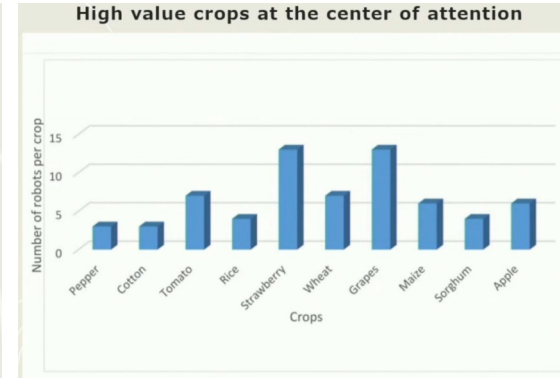
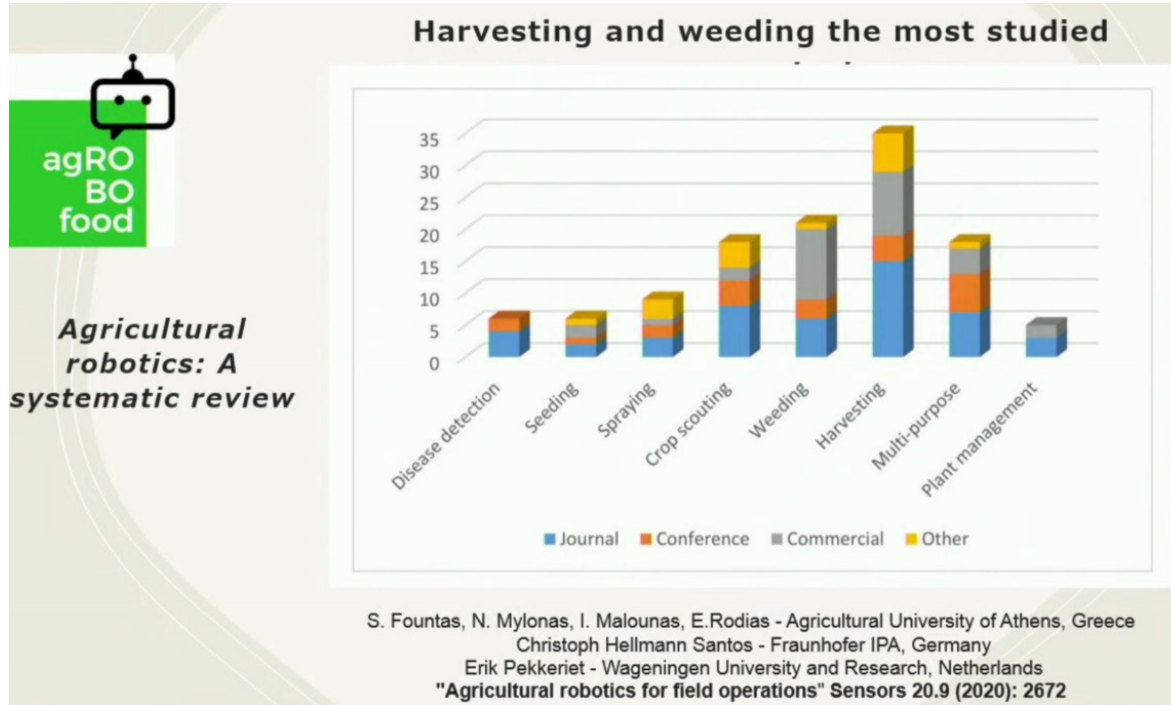
- Selective/ Spot spraying
- Nozzles mounted on the platform/implement or robotic manipulator
- Real-time detection (not popular yet)
- >90% coverage
- Low operational speed



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# Robot types

Source: FIRA 2021





# Examples

Vineyards



Traxx - <https://exxact-robotics.com/en/>



Bakus - <https://vitibot.fr/>



Burro - <https://burro.ai/>

# Examples

Tractors with hitch



Trektor - <https://www.sitia.fr/en/innovation-2/trektor/>



Robotti - <https://agointelli.com/>

# Examples

Orchards



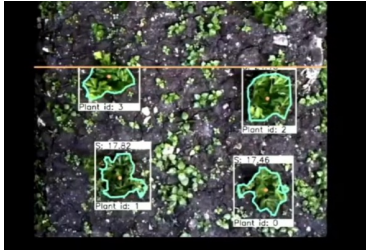
Tevel - <https://www.tevel-tech.com/>



FFRobotics - <https://www.ffrobotics.com/>

# Examples

Vegetables



Earth Rover - <https://www.earthrover.farm/>



Farmwise - <https://farmwise.io/>



Robot one - <https://pixelfarmingrobotics.com/>

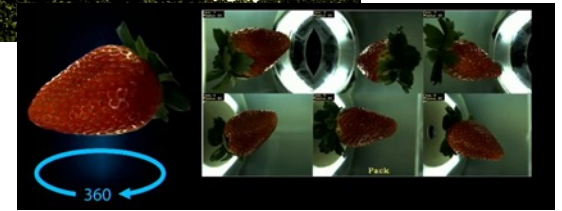
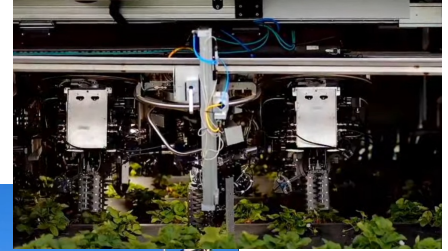
# Examples

Phenotyping



Meropy Sentiv - <https://meropy.com/en/robot.html>

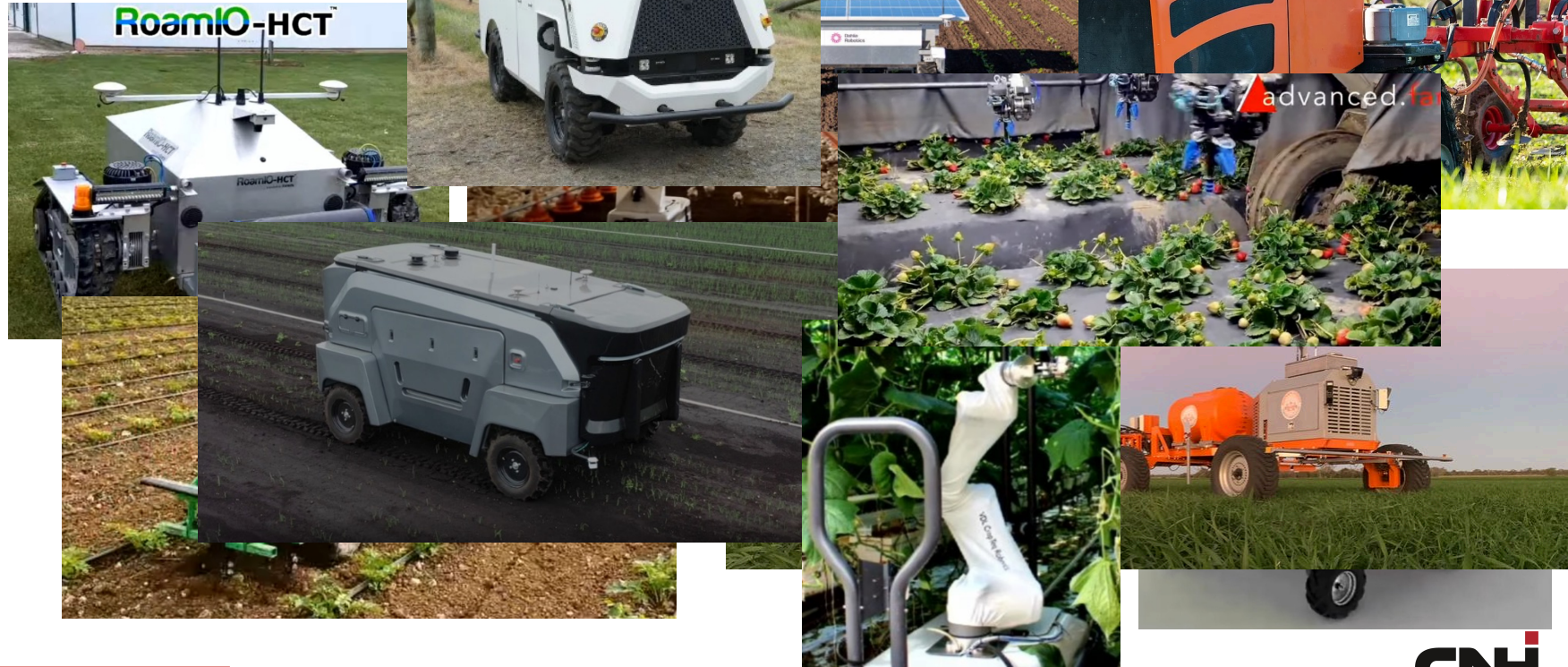
Strawberries



Harvest Croo - <https://www.harvestcroorobotics.com/>

# Examples

The list is endless



# Examples

More resources available on-line

The screenshot shows the ducksize.com website. The header includes the brand name 'ducksize' and navigation options for 'Robots per crop', 'Robots per task', 'Robots to replace tractor', 'Robot field experience', and 'More...'. The main content area is divided into three columns: 'See robots listed per task', 'Robot overview per crop', and 'Multi-purpose robots'. Each column contains a list of tasks or crops with corresponding robot images and category buttons. For example, under 'See robots listed per task', there are buttons for Weeding, Sowing, Tillage, Spraying, Insect-removal, and Inspecting robots.

This screenshot shows an article from PlugandPlay titled '10 Agriculture Automation Companies Shaping the Future of Farming' by Linly Ku, published on Oct. 06, 2021. The article is categorized under 'AGRI' and 'AGRI TECH'. The main image features a blue tractor in a field.

This screenshot shows a blog post titled 'Top 10 Robotic Applications in the Agricultural Industry' by Alex Owen-Hill, last updated on May 26, 2022 at 4:51 PM. The post is dated August 01, 2017, at 7:00 AM and has a 6-minute read time. The main image shows a drone flying over a field. The article discusses how robots are changing agriculture, from robot-assisted milking to cow-herding and drones.

This screenshot shows an article from Canopy titled 'The Robots are Coming'. The article is part of a partnership with Wine-searcher and is written by Christophe Coréghis, an expert on vineyard mechanization at the French Vine and Wine Institute. The main image shows a blue tractor in a vineyard.

This screenshot shows an article titled 'Top 10 Agricultural Robots Revolutionizing Farming in 2021' by Sayantani Sanyal, published on November 15, 2021, with a 3-minute read time. The article is categorized under 'Latest News' and 'Robotics'. The main image shows a white robotic arm working in a greenhouse.

# Outlook and opportunities

- Industry transitioning from early adopter to early majority
  - Many commercial products available today
  - Even more under development
- Remaining challenges
  - Robust operation (ODD)
  - Functional safety (EU machinery directive)
  - Speed of operation
- Open questions
  - Ideal form factor?
  - Ideal business model? Own/lease/RaaS?



<https://www.agreenculture.net/ceol>



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## DOMAIN COMPLIANCE REVIEW

The conformity review of your winery consists in carrying out the eligibility of your plots of land to the vines robotics.  
The good functioning of the Bakus is conditioned by a **well-kept vineyard in conformity** with its technical capacities.  
**Autonomous work in plots** requires identification of the environment in which the electric straddle carrier operates.



<https://vitibot.fr/>



# Backup